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**IN THE UNITED STATES PATENT AND TRADEMARK OFFICE**

**Applicant:** Peter Krulevitch, et al.

**Attorney Docket No.:** IL-10581

**Serial No.:** 09/851,231

**Group Art Unit:** 1772

**Filed:** 05/07/2001

**Examiner:** Catherine A. Simone

**For:** METHOD FOR PRODUCING MICROCHANNELS HAVING CIRCULAR CROSS-SECTIONS IN A GLASS

**Commissioner for Patents**  
**Alexandria, VA 22313-1450**

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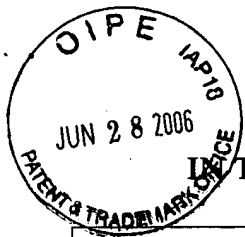
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**Kathy Raymond**

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PATENT

## THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicant :	Peter Krulevitch, et al.	Docket No. :	IL-10581
Serial No. :	09/851,231	Art Unit :	1772
Filed :	05/07/2001	Examiner :	Catherine A. Simone
For :	METHOD FOR PRODUCING MICROCHANNELS HAVING CIRCULAR CROSS-SECTIONS IN A GLASS		

**TRANSMITTAL OF APPELLANTS' BRIEF ON APPEAL**  
**(PATENT APPLICATION - 37 CFR 192)**

Transmitted herewith in **duplicate** is the **APPELLANTS' BRIEF ON APPEAL** in this application with respect to the Notice of Appeal filed on May 2, 2006.

The item(s) checked below are appropriate:

**1. STATUS OF APPLICANT**

This application is on behalf of

- ☐ other than a small entity.  
☒ a small entity.

A verified statement

- ☐ is attached  
☒ already filed.

**2. FEE FOR FILING APPEAL BRIEF**

Pursuant to 37 CFR 1.17(e) the fee for filing the Appeal Brief is:

- ☒ small entity \$250.00  
☐ other than a small entity \$500.00

Appeal Brief fee due **\$250.00**

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### 3. EXTENSION OF TIME

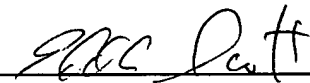
- ☐ Applicant petitions for an extension of time under 37 CFR 1.136

Calculation of extension fee (37 CFR 1.17(a)-(d)):

	Total months <u>requested</u>	Fee for other than <u>small entity</u>	Fee for <u>small entity</u>
<input type="checkbox"/>	one month	\$120.00	\$60.00
<input type="checkbox"/>	two month	\$450.00	\$225.00
<input type="checkbox"/>	three month	\$1,020.00	\$510.00
<input type="checkbox"/>	four month	\$1,590.00	\$795.00
<input type="checkbox"/>	five month	\$2,160.00	\$1,080.00
		Fee	<u>\$000.00</u>

### 4. FEE PAYMENT

- Charge Account No. 12-0695 in the amount of \$250.00.
- Charge Account No. 12-0695 for any additional extension and/or fee required or credit for any excess fee paid.

  
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Date: June 20, 2006



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On June 28, 2006

Kathy Raymond  
Kathy Raymond

PATENT

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicant :	Peter Krulevitch, et al.	Docket No. :	IL-10581
Serial No. :	09/851,231	Art Unit :	1772
Filed :	05/07/2001	Examiner :	Catherine A. Simone
For :	METHOD FOR PRODUCING MICROCHANNELS HAVING CIRCULAR CROSS-SECTIONS IN A GLASS		

Honorable Commissioner for Patents  
Alexandria, VA 22313-1450

Attention: Board of Patent Appeals and Interferences

Dear Sir:

APPELLANT'S BRIEF (37 C.F.R. § 1.192)

This brief is submitted in support of appellant's notice of appeal from the decision of the Examiner, mailed April 11, 2006 finally rejecting claims 11-19 of the subject application.

Appellant's notice of appeal was mailed May 2, 2006.

One copy of the brief is being transmitted per 37 C.F.R. § 41.37.

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## **I. REAL PARTY IN INTEREST**

The real party in interest is:

The Regents of the University of California and the United States of America as represented by the United States Department of Energy (DOE) by virtue of an assignment by the inventor as duly recorded in the Assignment Branch of the U.S. Patent and Trademark Office.

## **II. RELATED APPEALS AND INTERFERENCES**

There are no related appeals or interferences.

## **III. STATUS OF CLAIMS**

The application as originally filed contained claims 1-19.

Claims 1-10 are withdrawn.

The status of all the claims in the proceeding (*e.g.*, rejected, allowed or confirmed, withdrawn, objected to, canceled) is:

Claims 11-19 are rejected.

The claims on appeal are claims 11-19.

Claims 11-19 on appeal are reproduced in the Appendix.

## **IV. STATUS OF AMENDMENTS**

There have been no amendments filed subsequent to the Final Rejection mailed April 11, 2006.

## V. SUMMARY OF CLAIMED SUBJECT MATTER

The invention claimed in Appellants' independent claims 1 and 17 is described in Appellants' specification and shown in Appellants' drawings (reproduced below) as follows:

**"an apparatus having a sealed open microchannel therein comprising:"**

**(1) a substrate 10** (*Claim 1 - etched open substrate & Claim 17 - providing an etched open substrate*),

**(2) an etched microchannel 11 in substrate 10** (*Claim 1 - etched open microchannel on said etched substrate & Claim 17 - providing an etched open microchannel in said etched substrate*),

**(3) a second substrate 12** (*Claim 1 - annealed substrate & Claim 17 - providing an annealed substrate*),

**(4) an annealed microchannel in second substrate 12** (*Claim 1 - annealed open microchannel in said annealed substrate & Claim 17 - produced by annealing said annealed substrate*), and

**(5) a bond connecting said etched substrate to said annealed substrate** (*Claim 1 - said etched open microchannel and said annealed open microchannel comprise said sealed open microchannel & Claim 17 - providing a bond.*)

The invention overcomes problems associated with microchannels patterned into glass, silicon, or plastic substrates wherein the channel cross sections have sharp corners. Microchannels with circular cross-sections are highly desirable, but previously have been extremely difficult, if not impossible, to achieve.

Appellants' independent claim 17 is a product-by-process claim describing the invention as shown in Appellants' drawings (reproduced below):

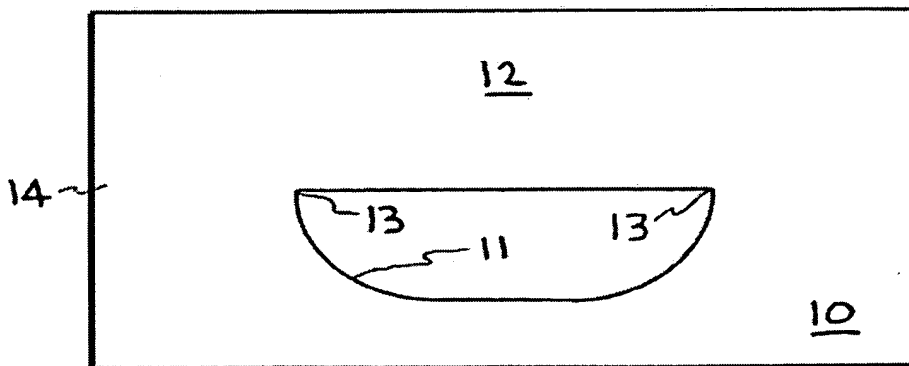
**"an apparatus having a sealed open microchannel therein, produced by the method comprising:"**

- (1) Providing the substrate 10.**
- (2) The etched open microchannel 11 is formed in the substrate 10.**



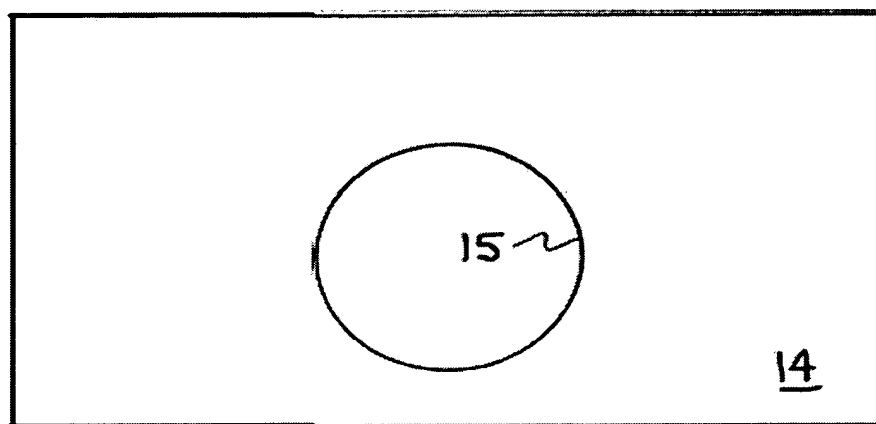
**FIG. 1**

- (3) The second substrate 12 is positioned over the substrate 10.**



**FIG. 2**

**(4) Providing an annealed open microchannel in said etched substrate produced by annealing.** The combination is annealed at a sufficiently high temperature such that the substrate 10 and second substrate 12 softens increasing diffusion rates and the microchannel cross-section becomes circular to lower its overall surface energy. Fusion bonding of substrate 10 and plate 12 results in a unified device 14. **This provides the circular microchannel 15 composed of the etched microchannel 11 and the annealed microchannel.**



**FIG. 3**

**(5) Providing a bond connecting said etched substrate to said annealed substrate (results in a unified device 14).**

The present invention provides an approach which basically involves etching a channel into a glass substrate, fusion bonding (or glass-glass anodic bonding) a glass substrate over the formed channel, and annealing the glass which transforms the channel cross-section to a circle. Other materials, such as polymers, may be utilized in this invention.

Microchannels with circular cross-sections are highly desirable, but previously have been extremely difficult, if not impossible, to achieve. The method of this invention is simple, cost effective, and produces satisfactory results. The present invention involves producing microchannels having circular cross-sections, particularly in glass substrates. The method is basically a three (3) step operation composed of etching, bonding, and annealing. Preferably the micro-channels are etched into a glass substrate, a glass plate is fusion or anodically bonded to the substrate, and the bonded substrate and plate are then annealed, with circular microchannels being produced thereby. A silicon wafer can be anodically bonded to an etched glass substrate and then annealed to produce microchannels having circular cross-section.

The amount of time required for the process depends on the anneal temperature, and also on the microchannel size. The surface tension forces pulling the cross-section into a circular shape is greater for smaller diameter microchannels. For example with glass substrate 10 having a thickness of 1mm with microchannel 11 having a depth of  $10\mu\text{m}$  and width of  $20\mu\text{m}$ , and glass top plate 12 having a thickness of 1mm, the annealing temperature would be  $600^{\circ}$  to  $800^{\circ}\text{C}$ , depending on the composition of the glass in substrate 10 and plate 12, and the annealing time to produce circular microchannels would be 5 to 20 hrs. This results in the device 14 having a circular microchannel 15 composed of the etched microchannel 11 and the annealed microchannel.

Appellants are providing a concise explanation of the subject matter defined in each of the independent claims involved in the appeal, which refer to the specification by page and line number, and to the drawing, if any, by reference characters. Appellants' claims on appeal do not contain means plus function or step plus function.

There are two (2) independent claims involved in the appeal. Appellants' two independent claims involved in the appeal are claims 11 and 17. Appellant's two independent claims 11 and 17 on appeal are "read on" Appellant's original specification in a side-by-side comparison with the specification page and line number in parentheses.

Claim 11

An apparatus having a sealed open microchannel therein, comprising:

an etched open substrate,

an etched open microchannel in said etched substrate,

an annealed substrate positioned on said etched substrate that covers said etched microchannel in said etched substrate,

Specification & Drawings

Figure 3 showing a circular microchannel formed by annealing the bonded structure of Figure 2. **(Page 5, lines 1-2)**

Figure 1-3 illustrate the process of the present invention with Figure 1 showing an etched substrate, **(Page 4, lines 22-23)**

In step 1, a glass substrate 10, see Figure 1, is isotropically etched to form microchannels 11, only one shown. **(Page 6, lines 6-7)**

In step 2, a second glass cover substrate or top plate 12 is fusion (or anodic) bonded, see Figure 2, to the first substrate 10, **(Page 5, lines 11-12)** Finally, step 3, as shown in Figure 3, involves annealing the bonded device or part of Figure 2 **(Page 7, lines 15-16)**

#### Claim 11 (Continued)

an annealed open microchannel in said annealed substrate over said etched microchannel in said etched substrate, and

a bond connecting said etched substrate to said annealed substrate, wherein said etched open microchannel and said annealed open microchannel comprise said sealed open microchannel.

#### Claim 17

An apparatus having a sealed open microchannel therein, produced by the method comprising:

providing an etched open substrate,

#### Specification & Drawings

a second glass cover substrate or top plate 12 is fusion (or anodic) bonded, see Figure 2, to the first substrate 10, **(Page 6, lines 11-12)** Finally, step 3, as shown in Figure 3, involves annealing the bonded device or part of Figure 2 at a sufficiently high temperature such that the glass in fused device 14, composed of substrate 10 and in cover or top plate 12, softens, increasing diffusion rates. **(Page 7, lines 15-18)**

A matched pair of substrates must be precisely aligned, such as using lithographically patterned metal alignment markers, and bonded together. **(Page 6, lines 21-22)** This results in an end produce or glass device 14 having a circular microchannel 15, sealed therein, as shown in Figure 3. **(Page 7, lines 20-21)**

#### Specification & Drawings

Figure 3 showing a circular microchannel formed by annealing the bonded structure of Figure 2. **(Page 5, lines 1-2)**

Figure 1-3 illustrate the process of the present invention with Figure 1 showing an etched substrate, **(Page 4, lines 22-23)**

### Claim 17 (Continued)

providing an etched open microchannel in said etched substrate,

providing an annealed substrate positioned on said etched substrate that covers said etched microchannel in said etched substrate,

providing an annealed open microchannel in said etched substrate produced by annealing said annealed substrate, and

providing a bond connecting said etched substrate to said annealed substrate, wherein said etched open microchannel and said annealed open microchannel comprise said sealed open microchannel.

### Specification & Drawings

In step 1, a glass substrate 10, see Figure 1, is isotropically etched to form microchannels 11, only one shown. **(Page 6, lines 6-7)**

In step 2, a second glass cover substrate or top plate 12 is fusion (or anodic) bonded, see Figure 2, to the first substrate 10, **(Page 5, lines 11-12)**

Finally, step 3, as shown in Figure 3, involves annealing the bonded device or part of Figure 2 **(Page 7, lines 15-16)**

a second glass cover substrate or top plate 12 is fusion (or anodic) bonded, see Figure 2, to the first substrate 10, **(Page 6, lines 11-12)**

Finally, step 3, as shown in Figure 3, involves annealing the bonded device or part of Figure 2 at a sufficiently high temperature such that the glass in fused device 14, composed of substrate 10 and in cover or top plate 12, softens, increasing diffusion rates. **(Page 7, lines 15-18)**

A matched pair of substrates must be precisely aligned, such as using lithographically patterned metal alignment markers, and bonded together. **(Page 6, lines 21-22)**

This results in an end produce or glass device 14 having a circular microchannel 15, sealed therein, as shown in Figure 3. **(Page 7, lines 20-21)**

## VI. GROUNDS OF REJECTION TO BE REVIEWED ON APPEAL

The Final Rejection mailed March 6, 2006 states two grounds of rejection. The grounds of rejection are summarized as follows:

**First Grounds of Rejection** - Claims 11, 13-15, 17, and 19 are rejected under 35 U.S.C. §102 (b) as being anticipated Cammack et al (U.S. Patent No. 5,574,327). The first grounds of rejection is stated in numbered paragraph 2, on page 2, of the Final Rejection mailed April 11, 2006.

**Second Grounds of Rejection** - Claims 12, 16, and 18 are rejected under 35 U.S.C. §103 (a) as being unpatentable over Cammack et al (U.S. Patent No. 5,574,327). The second grounds of rejection is stated in numbered paragraph 4, on page 3, of the Final Rejection mailed April 11, 2006,

## VII. ARGUMENT

**Arguments Directed to First Grounds of Rejection** – Appellants' Claims 11, 13-15, 17, and 19 on appeal are not anticipated by the Cammack et al reference because the Cammack et al reference does not show

“an annealed open microchannel in said annealed substrate over said etched microchannel in said etched substrate” (Appellants' independent claim 11) or

“providing an annealed open microchannel in said etched substrate produced by annealing said annealed substrate” (Appellants' independent claim 17).

In addition, the apparatus disclosed in the Cammack et al reference does not show the claim elements of Appellants' dependent claims defined as:

“wherein said annealed microchannel is a high temperature annealed microchannel annealed in the 600° to 800° range” (dependent claim 12) or

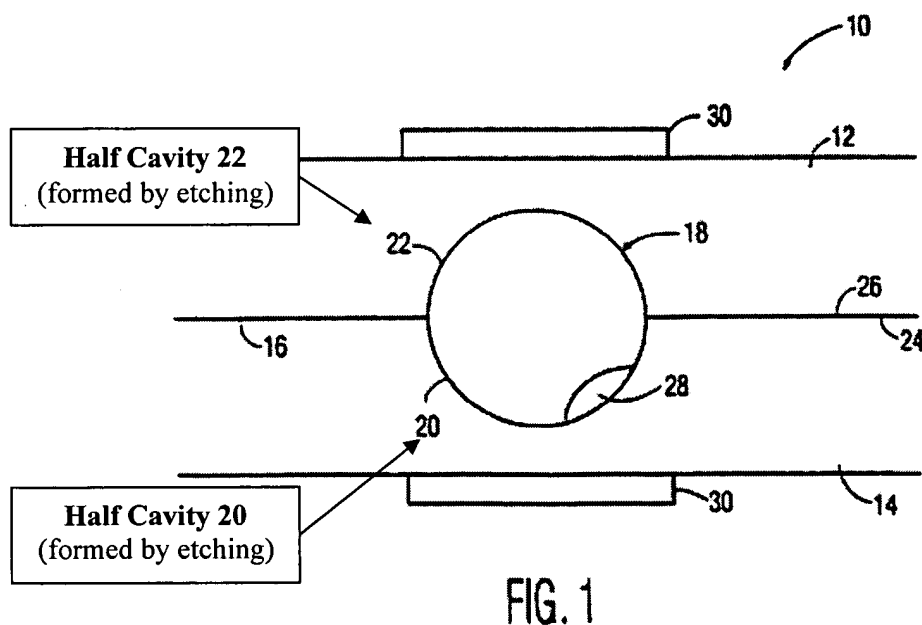
“wherein said annealed microchannel has depth of about 10  $\mu\text{m}$  and a width of about 20  $\mu\text{m}$  and said annealed microchannel is a high temperature annealed microchannel annealed in the 600° to 800° range” (dependent claim 16), or

“wherein said annealed open microchannel is produced by annealing said annealed substrate at a high temperature in the 600° to 800° range” (dependent claim 18, or

“wherein said etched microchannel in said etched substrate and said annealed open microchannel in said annealed substrate form a circular microchannel” (dependent claim 19).

#### The Cammack et al Reference

The Cammack et al apparatus shows half cavities 20 and 22 formed by etching. The “half cavities formed by etching” are contrasted with Appellants’ “annealed microchannel produced by annealing.” This is illustrated by FIG. 1 of the Cammack et al Reference reproduced below with legends added identifying the half cavities 20 & 22.



The fact that half cavity 20 and half cavity 22 are formed by etching is clearly described in the Cammack et al reference. The half cavity 20 and half cavity 22 formed by etching are described in the Cammack et al reference as:

**"The upper surface 24 of un-etched substrate 14 is covered by suitable masking material, such as polysilicon, at the portions where etching is not desired, as etching will occur at the unmasked portions. Thereafter, the masked substrate is exposed to an etchant such as hydrofluoric acid for a time suitable to create cavity 20. The time and amount of exposure to the etchant may be adjusted, in the known manner, to provide the cavity size and shape desired. Upper substrate 12 is also masked and etched in a similar manner to provide half cavity 22." (Col. 6, lines 4-13 of the Cammack et al Reference)**

**Cammack et al Half Cavities 20 & 22 Formed by Etching And Subsequently Annealed Do Not Anticipate Appellant's Annealed Microchannel**

The Final Rejection mailed April 11, 2006 relies upon the following statements near the bottom of page 5 of the Final Rejection mailed April 11, 2006:

**"Cammack et al clearly teaches two substrates (Fig. 1, elements 14 and 12) each having microchannels (Fig. 1, elements 20 and 22) being etched (see col. 6, lines 4-13) and then are annealed (see col. 9, lines 44-49)." (Page 5 of Final Rejection Mailed April 11, 2006)**

The Cammack et al statements that etched microchannel half cavity 20 and etched microchannel half cavity 22 are subsequently annealed does not provide anticipation of Appellants' claim element, "annealed open microchannel/ providing an annealed open microchannel" of Appellants' independent claims 11 and 17.

Appellants' claim element is an annealed microchannel that is formed by annealing. The Cammack et al microchannel half cavities are etched and subsequently annealed.

Interpenetration of Appellants' Claim Element "An Annealed Microchannel"

Appellants' claim element is interpreted by (1) Appellants' claims, (2) Appellants' specification, and (3) Appellants' prosecution history. When these three portions of Appellants' patent application are considered it is clear that Appellants' independent claim 11 claim element is a microchannel formed by annealing.

Appellants' independent claim 11 claim element is specifically described as "an annealed open microchannel." This element of Appellants' independent claim 11 is specifically described as:

"an annealed open microchannel in said annealed substrate over said etched microchannel in said etched substrate."

Appellants' independent claim 17 claim element is clearly a microchannel formed by annealing. Appellants' independent claim 17 claim element is specifically described as:

"providing an annealed open microchannel in said etched substrate produced by annealing said annealed substrate"

Appellants' claim element is a microchannel formed by annealing and this is different from the Cammack et al "half cavities that are etched and subsequently annealed." Accordingly the Cammack et al reference does not provide anticipation of Appellants' claims.

The Final Rejection mailed April 11, 2006 is using a common or dictionary definition of the term "annealed" in interpreting Appellants' claim elements and in interpreting the Cammack et al reference.

The United States Court of Appeals for the Federal Circuit in *Phillips v AWH Corp. (en banc)* (July 12, 2005) addressed patent claim construction. Significantly, the decision rejected the view, expressed in a number of recent Federal Circuit cases, that dictionary definitions should be a primary source for determining the meaning of disputed claim terms. Rather, the court reiterated its rulings from earlier cases that the claims, patent specification and prosecution history are the main sources for claim construction.

In *Phillips*, the court discussed various sources of evidence relevant to claim construction, starting with the "intrinsic" evidence, which consists of the claims themselves, the balance of the patent's specification, and the prosecution history of the patent. First, it discussed the primary role of the patent claims, noting that the claim language provides the "objective baseline from which to begin claim interpretation." In addition, the court noted that surrounding language within the claim, and other claims in the patent, such as dependent claims, are important to claim construction. As to the specification, the court quoted a prior decision that it is the "single best guide to the meaning of a disputed term." It encouraged courts to "rely heavily" on the specification to determine claim meaning. The opinion also notes that courts should consult the prosecution history to ascertain the proper meaning of claim terms, but that it is typically less useful than the specification. Second, the court discussed the proper use of "extrinsic" evidence, including dictionaries, treatises and expert testimony. It stated that, while extrinsic evidence may be helpful in determining claim meaning, it is "less significant" and generally "less reliable" than the intrinsic evidence.

When Appellants' claims, patent specification, and prosecution history are used to interpret the claim element "annealed microchannel" it is clear this element is formed by annealing, not formed by etching and subsequently annealed as disclosed in the Cammack et al reference.

Appellants' Claims 17, 18, and 19 are Product by Process Claims

A product-by-process claim defines a product in terms of the method (manipulative steps) used to manufacture the same. This type of claiming can be used when there is difficulty describing a product by a patent claim.

Appellants' independent claim 17 includes the claim element, "providing an annealed open microchannel in said etched substrate produced by annealing said annealed substrate." Appellants' dependent claims 18 and 19 include the claim elements, "wherein said annealed open microchannel is produced by annealing said annealed substrate at a high temperature in the 600° to 800° range" and "wherein said etched microchannel in said etched substrate and said annealed open microchannel in said annealed substrate form a circular microchannel."

Appellants' product-by-process claims 17, 18, and 19 are appropriate in this patent application because there is difficulty describing Appellants' invention using standard apparatus claims. The fact that the Final Rejection mailed April 11, 2006 rejects Appellants' standard apparatus claims 11-16 shows there is difficulty describing Appellants' invention using standard apparatus claims. Also, the fact that the Final Rejection mailed April 11, 2006 relies upon the Cammack et al reference showing microchannels that are etched and subsequently annealed indicates the difficulty in describing Appellants' invention using standard apparatus claims.

Appellants' product-by-process claims 17, 18, and 19 describe the differences between Appellants' invention and the prior art Cammack et al

device. Appellants' claim element is an annealed microchannel that is formed by annealing. The Cammack et al device has microchannels that are etched and subsequently annealed.

Cammack et al Reference does Not Anticipate Appellants' Invention

The standard for a 35 U.S.C. §102 rejection is stated in *RCA Corp. v. Applied Digital Systems, Inc*, 221PQ 385, 388 (d. Cir. 1984) "Anticipation is established only when a single prior art reference discloses, either expressly or under principles of inherency, each and every element of a claimed invention."

As described above, Applicants' following claim elements are not found in the Cammack et al reference:

"an annealed open microchannel in said annealed substrate over said etched microchannel in said etched substrate" (Appellants' independent claim 11) or

"providing an annealed open microchannel in said etched substrate produced by annealing said annealed substrate" (Appellants' independent claim 17).

Since the claim elements are not found in the Cammack et al reference, the Cammack et al reference does not anticipate Appellants' claims and does not support a 35 U.S.C. §102(b) rejection.

Further, Applicants' additional claim elements, "wherein said annealed microchannel is a high temperature annealed microchannel annealed in the 600° to 800° range" and "wherein said annealed microchannel has depth of about 10  $\mu\text{m}$  and a width of about 20  $\mu\text{m}$  and said annealed microchannel is a high temperature annealed microchannel annealed in the 600° to 800° range" and "wherein said annealed open microchannel is produced by annealing said annealed substrate at a high temperature in the 600° to 800° range" and "wherein said etched microchannel in said etched substrate and said annealed open

microchannel in said annealed substrate form a circular microchannel” Since these additional claim elements are not found in the Cammack et al reference, the Cammack et al reference does not support a 35 U.S.C. §102(b) rejection.

**Arguments Directed to Second Grounds of Rejection** - The invention defined by claims 12, 16, and 18 on appeal is unobvious over the Cammack et al reference.

The factual inquiries set forth in *Graham v. John Deere Co.*, 383 U.S. 1, 148 USPQ 459 (1966) that are applied for establishing a background for determining obviousness under 35 U.S.C. 103(a) include “Ascertaining the differences between the prior art and the claims at issue.”

**Differences between Cammack et al Reference and Appellants’ Invention**

The differences between the Cammack et al reference and Appellants’ invention defined by claims 12, 16, and 18 includes the fact that the elements of claims 12, 16, and 18 are not found in the Cammack et al reference. As explained above, the following elements of Appellants’ claims 12, 16, and 18 are not found in the Cammack et al reference:

“an annealed open microchannel in said annealed substrate over said etched microchannel in said etched substrate” or

“wherein said annealed microchannel is a high temperature annealed microchannel annealed in the 600° to 800° range” or

“providing an annealed open microchannel in said etched substrate produced by annealing said annealed substrate” or

“wherein said annealed microchannel has depth of about 10  $\mu\text{m}$  and a width of about 20  $\mu\text{m}$  and said annealed microchannel is a high temperature annealed microchannel annealed in the 600° to 800° range” or

"wherein said annealed open microchannel is produced by annealing said annealed substrate at a high temperature in the 600° to 800° range."

No Teaching to Modify Cammack et al Reference

Under MPEP §2142, there must be some suggestion or motivation, either in the reference or in the knowledge generally available to one of ordinary skill in the art, to modify the reference. It should be noted that the teaching or suggestion to make the claimed combination and the reasonable expectation of success must both be found in the prior art, and not based on applicant's disclosure. In re Vaeck, 947 F.2d 488, 20 USPQ2d 1438 (Fed. Cir. 1991).

There is no suggestion or motivation to modify the Cammack et al reference to produce Appellant's invention defined by claims 12, 16, and 18. Since there is no suggestion or motivation to modify the Cammack et al reference, the Cammack et al reference does not support a 35 U.S.C. §103(a) rejection of Appellants' claims 12, 16, and 18.

Appellant's have responded to each point raised in the Final Rejection mailed April 11, 2006 and have rebutted each issue in the first and second grounds of rejection. It is respectfully requested that Appellant's claims 11-19 on appeal be allowed.

Respectfully submitted,

By: 

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Attorney for Appellants  
Registration No. 25,220  
Telephone No. (925) 424-6897

Date: June 20, 2006

## CLAIMS APPENDIX

11. An apparatus having a sealed open microchannel therein, comprising:  
an etched open substrate,  
an etched open microchannel in said etched substrate,  
an annealed substrate positioned on said etched substrate that covers said etched microchannel in said etched substrate,  
an annealed open microchannel in said annealed substrate over said etched microchannel in said etched substrate, and  
a bond connecting said etched substrate to said annealed substrate,  
wherein said etched open microchannel and said annealed open microchannel comprise said sealed open microchannel.

12. The apparatus of Claim 11, wherein said annealed microchannel is a high temperature annealed microchannel annealed in the 600° to 800° range.

13. The apparatus of Claim 11, wherein said etched microchannel in said etched substrate and said microchannel in said annealed substrate form a circular microchannel.

14. The apparatus of Claim 11, wherein said etched substrate and said annealed substrate are selected from the group consisting of glass, silicon, and polymers, and mixtures thereof.

15. The apparatus of Claim 11, wherein said bond comprises fusion or anodic bonding.

16. The apparatus of Claim 11, wherein said annealed microchannel has depth of about 10  $\mu\text{m}$  and a width of about 20  $\mu\text{m}$  and said annealed microchannel is a high temperature annealed microchannel annealed in the 600° to 800° range.

17. An apparatus having a sealed open microchannel therein, produced by the method comprising:

providing an etched open substrate,  
providing an etched open microchannel in said etched substrate,  
providing an annealed substrate positioned on said etched substrate that covers said etched microchannel in said etched substrate,  
providing an annealed open microchannel in said etched substrate produced by annealing said annealed substrate, and  
providing a bond connecting said etched substrate to said annealed substrate, wherein said etched open microchannel and said annealed open microchannel comprise said sealed open microchannel.

18. The apparatus of Claim 17, wherein said annealed open microchannel is produced by annealing said annealed substrate at a high temperature in the 600° to 800° range.

19. The apparatus of Claim 17, wherein said etched microchannel in said etched substrate and said annealed open microchannel in said annealed substrate form a circular microchannel.

## EVIDENCE APPENDIX

There are no evidence appendix entries.

## RELATED PROCEEDINGS APPENDIX

There are no related proceedings appendix entries.